Visual Salience Relations Reflect Perceptual Development in 5- and 6-Month-Old Infants

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Summary

What type of visual information can infants use to identify physical objects? Are certain features easier to use than others? How can we compare differences along two separate featural dimensions? Earlier we reported that when using differences that are equally salient, 6-month-old infants remember color, but not luminance differences (Kaldy, Blaser, & Leslie, 2004). In the present series of experiments, we studied **visual salience and working memory in younger (5-month-old) infants and contrasted their results with the results of the older age group**.

First, a preferential looking study was conducted to determine the luminance difference that is equally salient to a predetermined color difference. This step represents a novel application of a well-established method to approach the elusive concept of salience.

Calibrating isosalient stimuli is essential for sound comparison across different featural dimensions.

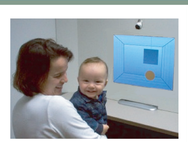
The second step consisted of a memory test using the same paradigm in which 6-month-olds were shown to be able to remember the color difference. We found negative results with the younger, 5-month-old age group.

Why salience?

Studies of infants' use of different features in object cognition (Wilcox, 1999; Kaldy & Leslie, 2003) faced difficult choices: for example, what kind of color change can be compared to a particular shape change? Differences in **visual salience (bottom-up priority value)** of objects constrained the interpretation of these earlier findings. Here we show a novel method to eliminate this problem and create stimulus pairs where the featural differences are equally salient.

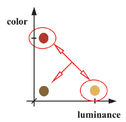
General method

Infants sat on their parent's lap and watched a computer-animated movie on a 21" LCD screen. Viewing distance was approx. 60 cm.



Step 1. Calibrating iso-salience

In our previous study (Kaldy *et al.*, 2004) we designed two stimulus pairs with **equally salient differences for 6-month-olds** using a preferential looking paradigm:
- a brown-red (isoluminant) color pair and
- a brown-yellow (isochromatic) luminance pair.



Here we tested the iso-salience point for younger, 5-month-old infants and contrasted their results with the data we obtained with 6-month-olds.

Method

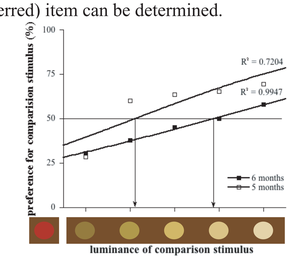
In each trial, infants saw two disks on a uniform brown background: a standard red disk (isoluminant to the background) and a lighter brown comparison disk (randomly chosen from 5 predetermined luminance levels).
Stimuli were presented for 2 seconds, and were followed by a central fixation cross (2 sec). A sound cue signalled the beginning of each trial. First looks (left/right) were coded by two experienced observers who were blind to the experimental stimuli. A max. number of 35 trials were run.

Subjects

10 full-term infants (5 females) participated in the study (age range: 5 months, 0 days - 5 months 30 days, mean age: 5 months 14 days).

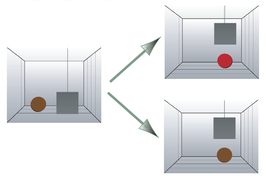
Results

Preference ratios for the different luminance level disks (against the red standard) are shown below. Data from the 5-month-olds is contrasted to the 6-month-olds from Kaldy *et al.* (2004). From the psychometric function, the luminance value of the iso-salient (50% preferred) item can be determined.



The results have shown that the iso-salience point with respect to a fixed color difference is at a **much lower luminance** level for 5-month-olds compared to 6-month-olds.

Step 2. Comparing visual working memory for color in 5- vs. 6-month-olds



We tested 5-month-olds' visual working memory with the violation-of-expectation method using the same color difference that earlier had produced positive results with 6-month-olds.

Method

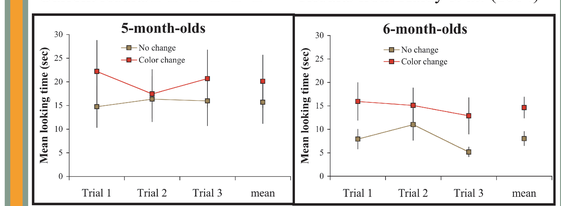
Subjects were first familiarized to a pair of objects that differed in either color (brown vs. red) or luminance (brown vs. yellow). 4 familiarization trials (with alternating objects) were run. The fam. trials were followed by 3 test trials: infants were shown one of the two objects in the fam. pair, which then disappeared behind a screen. After a 2 sec delay, either this same object, or the other object from the pair was revealed. Looking times were measured by two independent observers who were blind to conditions.

Subjects

36 full-term infants (15 females) participated in the study (age range: 5 months, 0 days - 5 months 30 days, mean age: 5 months 10 days), in equal number in each condition.

Results

Current results



Results from Kaldy *et al.* (2004)

no evidence for memory for color **p = n. s.**

significant memory for color **p = 0.029**

Results of the memory study have shown that 5-month-old infants did not reliably remember the color difference that 6-month-olds did in our earlier study. Younger infants looked longer in the *Color change* than in the *No change* condition, however, because of the considerable variation among subjects, the difference in looking time did not reach significance.

Conclusions

Visual salience is a crucial yet often neglected factor in infancy studies. Here we showed that this factor can be experimentally controlled using psychophysical methods.

Our earlier results (Kaldy *et al.*, 2004) showed that (1) 6-month-old infants can identify objects based on color, (2) when using iso-salient stimuli, color and luminance information are processed differently in infants' visual working memory.

We speculated that infants' better memory for color is adaptive, since the color of an object is a more reliable identifier than its luminance. Results of psychophysical studies with adults match our results (Sachtler & Zaidi, 1992).

The current study added two new pieces to the puzzle. First, we found that the luminance difference that is equally salient to a fixed color difference is much smaller in 5- than in 6-month-olds. We believe that this reflects the fact that color sensitivity is still developing during this period (Dobkins, Anderson, & Kelly, 2001).

Secondly, 5-month-old infants did not seem to remember the color difference in a simple object memory task as reliably as 6-month-olds did. This again might be a result of a relatively less mature color encoding system.

Future applications

The calibration method outlined here can be potentially applied to any featural dimension. Currently we are exploring salience relations between shape, luminance, color and motion with a slightly modified version of the paradigm presented here.

References

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